

The criteria for the written test for the recruitment of the post of Executive Engineer, DE-I and DE-II/JE of various disciplines above is as follows

1.	General Knowledge/Aptitude (Common for all Disciplines)	25 marks
2.	General Civil Engineering/General Electrical Engineering / General Electronics & Tele Communication Engineering (Specific to respective post like General Civil Engineering for Civil posts, General Electrical Engineering for Electrical posts & General Electronics and Tele Communication Engineering for Sig. & Tele. posts)	50 marks
3.	Specific to respective discipline of a. Civil Engineering (Track) Bridges, Viaducts, Railways, Metro, Railway Track, Ballastless Track	25 marks
	b. Electrical Engineering OHE/Traction, Power Supply and Traction sub stations in Railways & Metro.	25 marks
	c. Signal & Telecommunication Engineering Electrical Interlocking, Signalling, Train Control Systems, OFC & Quad cable Communication in Railways & Metro	25 marks
	Total	100 marks

CIVIL ENGINEERING

SYLLABUS FOR SELECTION OF EXECUTIVE ENGINEER/ DEPUTY ENGINEER-I/DEPUTY ENGINEER-II (TRACK/CIVIL ENGINEERING)

1. General Knowledge

1.1 Questions of general interest and importance acquired by general observation or reading without specific text book study; subjects of national importance.

1.2 The standard of general knowledge may not be more rigorous than 12th standard.

2. General Mathematics

2.1 Arithmetic, Trigonometry, statistical operations, graphs, fractions, percentage, averages.

2.2 Geometry – area & volumes up to 12th standard level.

2.3 Algebra – Simultaneous/Quadratic equations up to 12th standard level.

3. Civil Engineering (General)

3.1 Surveying.

3.2 Types

3.2.1 Chain and Compass Survey –

Basic principles; base lines; check lines; tick lines; perpendicular and oblique offsets; conventional signs; plotting of survey; true and magnetic bearings; open and closed traverses; recording plotting of traverse, closing errors.

3.2.2. Plane Table Survey –

Techniques of using Distomat and total stations. Method of setting layouts & curves using these equipments.

3.2.3 Levelling –

Level lines –datum, bench marks, simple levelling, fly levelling; recording the levels in field book; method of reducing levels; arithmetical check; longitudinal and cross-section contouring.

3.2.4. Theodolite Survey –

Types of theodolites; measurement of horizontal angles, vertical angles, magnetic bearings and deflection angles; prolonging a straight line; traversing by method of included angles; balancing the survey- closing errors; calculations of latitude and departure; use of theodolite as a tacheometer.

3.2.5 Curves –

Elements of simple circular curves; setting out simple circular curves; different methods.

3.2.6 Set out works-

Setting out buildings, culverts, Central line of Railway alignment. Usage of GPS technology in setting out Centre line of Railway alignments.

3.3 Care & Custody of Survey Instruments-

Handling of instruments – Transport and protection; permanent adjustments; repairs and periodical overhaul.

4 Strength of Materials, Structural Designs & Drawings

4.1 Strength of Materials-

Stress, strain, Hooke's Law, working stress, factor of safety' bending moment and shear force in simply supported beams and cantilevers; simple theory of bending; moving loads on simply supported beams; influence lines for bending moment and shear force in statically determinate beams; short columns, long columns – empirical formulae.

4.2 Structural Design & Drawngs

4.2.1 Steel Structures-

Riveted and welded joints; tension and compression members; plate girders, connections; IRS Code of Practice for Steel Structures; Sketching of connection details.

4.2.2 RCC Structures-

Slab- Single and 2-way reinforced; beams-rectangular, T and Doubly reinforced; Bending shear reinforcement; design of columns; footings, IRS Code of Practice of RCC structures; sketching of RCC details of simple structures. Use of computer aided softwares such as STAD, FEM etc. Basic requirements for usage of these computerized softwares.

5. Construction materials

Description, specification, properties and uses of building materials – Stones, sand, timber, bricks, cement, lime, building hardware, paint, varnishes, glasses, tiles.

5.1 Material Testing – Soil, Aggregates and Steels

6 Foundation and constructions engineering

6.1 Soil Mechanics-

Elements of Soil Mechanics – Physical properties of soils, compaction, field methods of compaction; stabilization of soils; safe-bearing capacity of soils; determination of safe-bearing capacity; earth pressure; plate loading test, specifications and construction of earthwork in embankments & cuttings.

6.2 Foundation Engineering-

Functions of foundations; different types of foundations; settlement of foundations; methods of reducing differential settlements; pile foundations; well foundations for bridges.

6.3 Buildings-

Brick and stone masonry; construction details-roofs, floors, staircases, joinery, scaffolding.

6.4 Reinforced & Prestressed Concrete

Bending and placing of reinforcement; fine and coarse aggregates; concrete mixing, laying and compaction; finishing of RCC surfaces; formwork, curing, testing

6.5 Steel Structures-

Standard rolled sections; fabrication templating straightening, drilling, riveting, bolting and welding; match marking; trial erections, testing, site erections- equipment, methods.

6.6 Construction Machinery & Equipments.

Drilling and blasting equipments for quarrying, tunnelling and excavation in rock, pile hammers and pile driving equipments, pumps, concrete mixers, vibrators, grouting equipments, air compressors, pneumatic tools and different types of cranes.

6.7 Types of cracks in building. Causes and prevention techniques for avoiding cracks in the buildings.

7 Hydraulics & Hydrology

7.1 Hydraulics-

Elements of hydraulics – Open Channel flow; flow pipes, frictional loss, empirical formulae.

7.2 Hydrology-

Rainfall and run-off; rainfall statistics; rain gauges, run-off calculations by empirical methods, flood discharge estimation; measurement of flood discharge-current meter.

7.3 Hydraulic Structures-

Design of bridges- alignment, number of spans; economic spans; waterways calculations; scour depth afflux; clearance; depth of foundations; BOX and Pipe Culverts, river training works=spurs, groynes, aprons, levees.

8 Public Health Engineering

8.1 Water Supply-

8.1.1 Quality of water- physical, chemical and bacteriological standards of water; water-borne diseases; water demand- methods of forecasting; sources of water; treatment of water- aeration, sedimentation, filtration (slow and rapid sand filters); disinfection, hardness- methods of removal.

8.1.2 Conveyance and Distribution:-

Pumping equipment; rising mains; systems of distribution, residual pressures; different types of pipes and fittings; testing of pipes.

8.1.3 Planning & design of layouts for rain water drains. Principles of rain water harvesting, methods, estimation of capacity of rain water harvesting pits/salient etc.

8.2 Sewerage:

9. Traffic Engineering

10. Estimating. Costing & Valuation

Civil Engineering (Railways)

1. Railway Surveys & Construction:-

Classification of surveys; principles governing location; ruling gradients; compensation of curves; vertical curves; hill surveys; catch sidings; tunnels; preparation of drawings; design of large bridges; progress reports on surveys; project estimates; standards of construction; junction arrangements; project report; preliminary arrangement for construction of new lines; letting out contracts; programme work; critical path networks; execution of work and measurements progress reports; completion works.

2. Railway Track:-

Description, specifications and functions of the structure elements; Rails, sleepers, fastening ballast, formation and other sub-structures; points and crossings' geometry and design features Track lay-outs.

2.1 Ballastless Track

3. Maintenance of Permanent Way:-

3.1 Maintenance of Permanent Way:-

Methods of maintenance; beater packing, Measured Shovel packing, Machine packing, Systems of maintenance; overhauling systematic through packing, picking up slacks, Directed Track Maintenance; Miscellaneous works; lifting and lowering of track, screening of ballast, Maintenance of drains, lubrication of rail joints; adjustment of creep, maintenance of level crossings, Maintenance of points and crossings;

3.2 Special Maintenance Works:

3.2.1. Maintenance of short welded rails, long welded and continuous welded rails, maintenance in electrified section; special precautions; maintenance of track circuited sections; special precautions.

3.2.2. Maintenance of curved track and realignment of curves; Curvature, transitions, super elevation of curves, safe speeds, cant deficiency, speed on curves with turnouts, Realignments of curves; method.

3.2.3 Testing of track with track recording car, frequency based on category, OMS frequency and category, interpretation of track recording charts; analysis of the charts to improve track parameters. The allowable limits of parameters category-wise, attention to track defects etc.

4. Maintenance of Bridges:

4.1 Inspection of bridges:

Records of inspection; details of bridge inspections, works connected with maintenance of bridges; laying of bridge sleepers; replacing cracked bed blocks; painting of steelwork.

5 Inspection & maintenance of buildings and structures other than bridges:

General instructions; additions and alterations to quarters; transfer of buildings; buildings registers; scale of accommodation and other facilities; vacant railway buildings; maintenance of buildings, inspections and repairs; petty repair books, periodical inspections; details of inspections; Maintenance aspects of cracked buildings and repairs to the existing cracks.

6 Maintenance of sanitary and hygienic conditions in station yards and railway colonies; water supply, drainage and sewerage:

6.1 Sanitation:

Formation of sanitation committees; inspection by sanitation committee; sanitary arrangements in stations and colonies drinking water wells – protection; Cleaning of wells; disinfection; prevention of infectious diseases; disinfection of quarters.

6.2 Water Supply:

Sources of water supply; water sample analysis; open wells – sizes; pumping capacity improving yield; shallow tube wells; deep tube wells; impounding reservoirs; storage capacity; flood discharge; record of water levels in wells; rainfall registers; high level storage tanks; precaution against pollution; pumps – types, selection, installation; aqueducts and pipelines-types selection, laying; estimating requirements of water; layout of distribution systems; water supply from outside sources; maintenance and operation of water supply installation – responsibilities of Engineering department and Mechanical department.

6.3 Drainage and Sewerage:

Drainage systems, waterborne sewerage; sizes of sewers; sewage treatment systems; sewage purification systems; surface drainage – layout, size of drains; disposal of sullage effluent; drainage of latrines; maintenance of sewerage and drainage systems; maintenance of open sullage drains; storm water drains; house connections; conservancy and sanitary arrangements; responsibilities of engineering staff.

7 Works affecting railway safety and opening new works:

General – Reference to rules; works requiring sanction of the ACRS and notice thereof; application to the ACRs – execution of work and Safety Certificates; documents to accompany applicant; submission of Safety Certificate; deviations from plans approved

by ACRS; applications for running of new types of locomotives and/or rolling stock and for increase in speed; notification to railway officials when opening works; works resulting from accidents; opening of new lines; infringement to Schedule of Dimensions – condonation; procedure thereof; movement of ODCs – types and procedure for sanction for movement, precautions during movements.

8 Railway Operation:

8.1 General/Organization:

Reference to General & Subsidiary rules, train working etc. and Organization at field/division level.

8.2 Engineering restrictions and indicators:

General – Definitions: Responsibility of the Inspector incharge; works of short duration; protection of line in block section and procedure for passing trains; works of long duration; temporary engineering fixed signals; arrangements prior to commencement of work; protection in block section for speed restrictions; procedure for blocking lines for engineering purposes; works at times of poor visibility; temporary signals in emergency; periodical notices of engineering restrictions; permanent speed restriction indicators; review of permanent speed restrictions' indicators – General.

9 Accidents:

General – Observance of rules; intimation of accidents by station masters; duties and responsibilities of the engineering officials in the event of accident impairing through traffic action at site, reporting details of accident – provisions of Accident Manual; action in case of derailments; examination of site and preparation of sketches; recording track and rolling stock measurements – accident procedure; use of recorded data; restoration of through running; procurement and arrangement of labour and equipment; temporary arrangements at site of accident; transshipment; funds required during emergencies; attendance of police at accidents; driver's reports on defects in track; action on receipt of reports of defective track; abnormal occurrence attributable to oscillation of locomotives; accidents not impairing through traffic; records of accidents.

10 Rivers & Floods, pre-monsoon precautionary measures and patrolling of Railway line:

10.1 Pre-monsoon precautionary measures:

Vulnerable sections; materials for anticipated emergencies; monsoon emergency rakes; equipment tools, rail clusters, temporary bridge spans; protective works; railway affecting tanks; inspection and vigilance over railway affecting tanks; pre-monsoon; during monsoon.

11 Preparation of plans and estimates:

11.1 Preparation of Plans-

General procedure; preparation of plans, sizes of drawings; titles and numbering of drawings; scale of drawings; details on drawings; symbols and colours of drawings.

11.2 Preparation of Estimates -

Preparations of estimates – Code rules; technical details, rates and quantities; schedule of rates and price, special features of estimates; Supplementary Estimates.

12 Contracts and Execution of works:

12.1 Contracts:-

General – Code reference for contracts; lists of approved contractors and registration of applications; Schedule of Rates; Analysis, non-scheduled rates, special rates; tenders; procedure, tender documents, drawings and specifications, tender committees, acceptance of tenders, contracts; procedure, contract documents, General and special conditions of contract; loan of tools and plant to contractors; issue of departmental materials to contractors; measurements and measurement books – code reference; recording measurements; 'on account' measurements; detail measurements; responsibilities of Inspectors and Assistant. Engineers for measurements of works; ballast measurements; computation of quantities; preparation of abstracts in measurement books; submission of bills; checking of bills; bill registers; disputes with contractors.

12.2 Execution of works:

General instructions – Code rules; agencies for executing works; responsibilities of executive officers; deposit works; excess and savings on estimates; departmental execution of work – record, progress reports, charges for stores and labour, execution of works in Engineering workshops; contracted works, issue of work Orders; completion documents; works pertaining to other departments.

SIGNAL & TELECOMMUNICATION

SYALLBUS FOR SELECTION OF EXECUTIVE ENGINEER/DEPUTY ENGINEER-1/DEPUTY ENGINEER-II

1. GENERAL KNOWLEDGE

- 1.1. Questions of general interests and importance acquired by general observation or reading without specific text book study; subjects of national importance.
- 1.2. The standard of general knowledge may not be more rigorous than 12th standard.

2. GENERAL MATHEMATICS

- 2.1. Arithmetic, Trigonometry statistical operations, graphs, fractions, percentage, averages.
- 2.2. Geometry – area & volumes up to 12th standard level.
- 2.3. Algebra – Simultaneous/Quadratic equations up to 12th standard level.

3. PHYSICS & BASIC ELECTRICITY

- 3.1. Temperature measurement
- 3.2. Mechanics – Newton's laws of motion, velocity & acceleration, work, energy power, Archimedes principle
- 3.3. Heat & work, expansion of solids, liquids & gases.
- 3.4. IC engines
- 3.5. Ohm's Law, coulomb's Law, Faraday's Law, Voltage, Current & Resistance, Power factor etc
- 3.6. Simple motors, Dynamos, transformers, Relays, Circuit breakers
- 3.7. Power supply, AC&DC Rectifiers

4. RULES & MANUALS

- 4.1. Signal Engineering Manual – Duties of Junior Engineers, Assistant Engineers, Executive Engineers
- 4.2. Different signalling schemes
- 4.3. Standards of Interlocking
- 4.4. Requirements for opening a New Signalling Installation/Section
- 4.5. Role of CRS

5. FUNDAMENTAL ENGINEERING & ALLIED TECHNOLOGY

- 5.1. Simple Structures
- 5.2. Dynamics
- 5.3. Magnetism & Electricity
- 5.4. Sound
- 5.5. Fundamental Electronics & Circuits'
- 5.6. Power supply Equipment & Systems
- 5.7. Lightening & Surge Protection Systems
- 5.8. Principles of Optics & Optical Fibre Communication Systems
- 5.9. Principle of Digital electronics
 - 5.9.1. Boolean Algebra
 - 5.9.2. Digital devices and their applications
- 5.10. Data Communication Principles & Information Technology
 - 5.10.1. Familiarity with PCs/Servers specifications
 - 5.10.2. Operating systems & Application software
 - 5.10.3. Networking systems – LAN/WAN,
 - 5.10.4. Router/Switches
- 5.11. Electrical Interlocking
 - 5.11.1. Interlocking Plans & Tables
 - 5.11.2. Automatic Signalling
 - 5.11.3. Electric Point machines
 - 5.11.4. LED Signals
 - 5.11.5. Relay interlocking Route setting/Non-Route setting
 - 5.11.6. Computer based Interlocking

- 5.11.7. Automatic train protection & warning systems
- 5.11.8. Automatic Train Operation
- 5.11.9. Centralized Train Control Systems
- 5.11.10. Train Management Systems
- 5.11.11. Audio Frequency Track circuits
- 5.11.12. Digital Axle Counters
- 5.11.13. Integrated Power Supply System/Uninterrupted Power Supply Systems

6. TELECOMMUNICATION

- 6.1. Underground Cable System
- 6.2. Power Plant Systems
- 6.3. OFC & Quad Cable Communication in RE areas
- 6.4. Electronic PBX & IP PBX
- 6.5. SDH/DWDM
- 6.6. Passenger Information Systems
- 6.7. Closed Circuit TV systems
- 6.8. Data communication & IP Networks
- 6.9. Mobile Train Radio – GSM (R), TETRA
 - 6.9.1. Frequency Allocation
 - 6.9.2. Licensing Procedures of DOT/WPC
- 6.10. Wifi/Wimax
- 6.11. Network Management Systems

ELECTRICAL ENGINEERING

SYLLABUS FOR SELECTION OF EXECUTIVE ENGINEER/DEPUTY ENGINEER- I/DEPUTY ENGINEER-II

1. GENERAL KNOWLEDGE

- 1.1. Questions of general interest and importance acquired by general observation or reading without specific text book study; subjects of national importance.
- 1.2. The standard of general knowledge may not be more rigorous than 12th standard.

2. GENERAL MATHEMATICS

- 2.1 Arithmetic, Trigonometry statistical operations, graphs, fractions, percentage, averages.
- 2.2. Geometry – area & volumes up to 12th standard level.
- 2.3 Algebra – Simultaneous/Quadratic equations up to 12th standard level.

1.0	GENERAL -
1.1	Net work analysis, Star/Delta, Transformation Symmetrical component, transients, Basics of Control Systems.
1.2	<p>Analog and Digital Electronics and Circuits: Semiconductor device physics, PN junctions and transistors, circuit models and parameters, FET, Zener, tunnel, Schotky, photo diodes and their applications, rectifier circuits, voltage regulators and multipliers, switching behaviour of diodes and transistors.</p> <p>Small signal amplifiers, biasing circuits, frequency response and improvement, multi-stage amplifiers and feed-back amplifiers, D.C.. AMPLIFIERS, Oscillators. Large signal amplifiers, coupling methods, push pull amplifiers, operational amplifiers and wave shaping circuits. Multi-vibrators and flip-flops and their applications. Digital logic gate families, universal gate combinational circuits for arithmetic and logic operation, sequential logic circuits. Counters, registers, RAM and RGMs.</p>
1.3	<p>Micro-processors: Micro-processor architecture Instruction set and simple assembly language programming. Interfacing for memory and I/O. Applications of Micro-processors in power system.</p>
1.4	<p>Power Electronics: Power semi-conductor devices. Thyristor. Power transistor (IGBT), GTOs and MOSFETs. Characteristics and operation. AC to DC Converters; 1-phase and 3-phase DC to DC Converters; AC regulators Thyristor controlled reactors, switched capacitor networks. Inverters; Single-phase and 3-phase. Pulse width modulation. Sinusoidal modulation with uniform sampling. Switched mode power supplies.</p>
1.5	<p>Communication Systems: Types of modulation; AM. FM and PM. Demodulators. Noise and bandwidth considerations. Digital communication systems. Pulse code modulation and demodulation. Elements of sound and vision broadcasting. Carrier communication. Frequency division and time division multiplexing, Telemetry system in power engineering. Fibre optic cable communication system.</p>
1.6	Indian Elect. Acts & Rules:
2.0	Electrical Engineering Materials:

	Band Theory, Conductors, Semi conductors and Insulators, Superconductivity. Insulators for electrical and electronic applications. Magnetic materials. Ferro and ferri magnetism. Ceramics: Properties and applications. Hall effect and its applications. Special semi-conductors. Insulating material classification/Therma affect, Solar PV modules.
3.0	Theory and performance of Electrical Machines & equipment:
3.1	Basic concepts in rotating machines. EMF, torque, basic machine types. Construction and operation, leakage, losses and efficiency.
3.2	Direct current machines: Generation of EMF, work, power, Torque equation, armature winding, armature, reaction, theory of commutation, Inter-poles & compensating windings, characteristics of shunts, series and compound generators, parallel running and load sharing of generators. Construction, Excitation methods. Circuit models characteristics and performance analysis. Generators and motors. Starting and speed control. Testing. Losses and efficiency.
3.3	Synchronous Machines. Construction. Circuit model. Operating characteristics and performance analysis. Synchronous reactance. Efficiency. Voltage regulation. Salient-pole machine. Parallel operation. Hunting. Short circuit transients.
3.4	Induction Machines. Construction. Principle of operation. Rotating fields, Characteristics and performance analysis. Determination of circuit model. Circle diagram, Starting and Speed control, Fractional KW motors. Single-phase synchronous and induction motors, 3-phase Asynchronous motors and induction motors for traction application.
3.5	Transformers: Construction and testing. Equivalent circuits. Losses and efficiency. Regulation. Auto-transformer. 3-phase transformer. Parallel operation. Methods of cooling, tap changing, Parallel operation, polarity and phase sequence testing, protection Instruments PTs & CTs, etc. Scott connection transformer.
4.0	Generation, Transmission & Utilisation -
4.1	Sources of energy, heat value of fuel, steam power station, Hydro Elect. Station, Nuclear power station. Pumped storage plants. Economic and operating factors.
4.2	Power transmission lines. Modelling and performance characteristics. Voltage control. Load flow studies. Optimal power system operation. Load frequency control. Symmetrical short circuit analysis. Z-Bus formulation. Symmetrical Components. Per Unit representation. Fault analysis. Transient and steady state stability of power systems. Equal area criterion. Power system Transients. Power System Protection Circuit breakers. Relays. HVDC transmission.
4.3	Illumination standards of light, polar curve, Reflection and absorption, lighting calculations including design & economical layout of service building workshop & yards. Various sources of light-fluorescent tubes etc.
4.4	Electric traction : Advantages & disadvantages, speed time curve-traction motor, starting & speed control of DC series motors, power, consumptions, Regenerative braking, advantages and disadvantages of AC traction over DC traction, Tractive effort, Braking Effort.
4.5	Group & individual drive. Choice of drive & motors for various usages.
5.0	Measurements & instrumentation -
5.1	Units and Standards. Error analysis Measurement of resistance (high & low), potentiometer, wheat stone & Kelvin bridge, meggers for insulation resistance & earth resistance.
5.2	Voltmeters, ammeter, power factor meter, single phase watt mater,

	measurements of three phase power recording instruments, maximum demand meter. Watt hour meter, shut , CT, PT.
5.3	Check meter.
5.4	Transducers and their applications to the measurement of non-electrical quantities like temperature, pressure, flow-rate displacement, acceleration, noise level, etc. Data acquisition systems. A/D and D/A converters.
6.0	Mechanical Engineering Refrigeration etc. -
6.1	Various types of drives, belt, tooth gearing, rope and chain drive and Helical gears. Different types of bearings, ball, roller etc.
6.2	Heat pump cycle, vapour compression, estimation of cooling and heating levels and plant capacities, calculation of psychometric charts, condensers cooling and dehumidification, refrigerant and their properties.
7.0	Logical Reasoning – The test is given to the candidates to judge their power of reasoning spread in verbal and non verbal areas. The candidates should be able to think logically so that they perceive the data accurately, understand the relationships correctly, figure out the missing number of words, and to apply rules to new and different contexts. These indicators are measured through performance on such tasks as detecting missing links, following directions, classifying words, establishing sequences, and completing analogies.
8.0	General Services
8.1	General power supply arrangements, air conditioning etc.
8.2	Power Supply: HT & LT sources, power supply network, substation layout, overhead & underground distribution, maintenance & operation of transformers switch gears, protective devices & distribution lines.
8.3	Construction, erection & commissioning of new sub-station distribution lines, line calculations etc.
8.4	House wiring metering & safety precautions.
8.5	Tariff & Agreements, Relative merits of obtaining HT & LT supply, steps to reduce maximum demand, measurement of power, power factor, measuring demand etc.
8.6	Water supply & requirement of water planning of water supply systems, sources of water pipe line frictional & other losses, discharge calculations.
8.7	Reciprocating centrifugal & turbine pumps, relative merit, choice of VS & HS pumps, characteristic curve of pumps, efficiency Drives, Elect. Connections & protections. Cavitations & priming of pumps, measurement of output with V-Notch & nozzle, necessity of multi stage pumping, storage capacity and purification of water.
8.8	Preventive maintenance, special failure of pumps & motors periodical overhaul.
8.9	Air-conditions and Refrigeration: Central air-conditioning plant & package type system, refrigeration cycle, air changes, planning for capacity and drives for refrigeration plants, refrigerants and ducting.
8.10	Specification, design & testing of water coolers, central as well as package plants. Requirements of water coolers, window coolers & refrigerators.
8.11	Standby arrangement: DG sets, both petrol & diesel as also diesel pumps for water supply arrangements. Operation maintenance and overhauling
8.12	Illumination, yard lighting, street lighting & town supply net work. Drives for workshop machinery.

8.13	Earthing & Bonding.
8.14	Commissioning & maintenance aspect of conventional & maintenance free earthing arrangement for general service application.
8.15	Energy Consumption, Renewable Energy, Solar, Wind and biomass.
9.0	Traction Distribution -
9.1	Systems of electrification in use and advantage and disadvantages of the different systems with emphasis on 2x25 KV system.
9.2	Power supply installation: Power supply arrangements, traction sub stations, feeding stations, SSP & SPs, 132 KV transmission lines, Railway owned sub stations, transformer maintenance, circuit breakers, current and potential transformers, protective relays, auxiliary transformers, interrupters and isolators.
9.3	Liaison with power supply authorities, monthly meter reading, control over maximum demand, emergency power supply arrangements. Automated Meter Reading.
9.4	Remote control system, remote control equipment for AC substations and its working. Operation and maintenance of remote control, Specialized equipments for remote control work.